

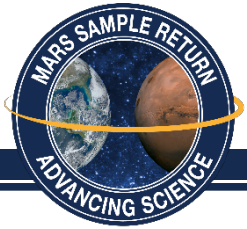
# Mars Sample Return Science Planning

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MSPG (MSR Science Planning Group: co-chairs M. Meyer and E. Sefton-Nash; facilitation D. W. Beaty and B. L. Carrier; and D. Bass, F. Gaubert, T. Haltigin, A. D. Harrington, M. M. Grady, Y. Liu, D. Martin, B. Marty, R. Mattingly, S. Siljestrom, E. Stansbery, M. Wadhwa, L. White)

MEPAG VM#5-June 6th, 2019

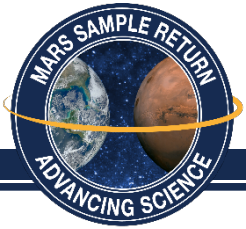


## What is the MSR Science Planning Group (MSPG)?

MSR Science Planning Group

MSPG has been established by NASA and ESA to help develop a stable foundation for international scientific cooperation for the purposes of returning and analyzing samples from Mars.

- Actions Requested:
  - Propose functional science-related attributes of a Sample Receiving Facility (SRF) that can be used as the basis for cost and schedule estimation (assume additional independent requirements will come from planetary protection).



# MSPG Workshops & Reports

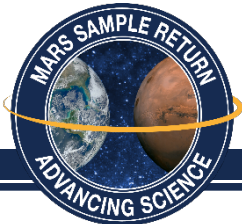
MSR Science Planning Group

- The main science-related cost drivers for the Sample Receiving Facility (SRF) are thought to be:
  1. BSL-IV capability and the science that must be done inside containment
  2. Contamination control
- Two workshops have been held to date to further evaluate:

To what extent does science need to be done in containment?

How do the science objectives affect contamination control requirements?

- Sample Management working group is evaluating options for developing a clear understanding of the science benefits of the MSR collaboration to all international stakeholders

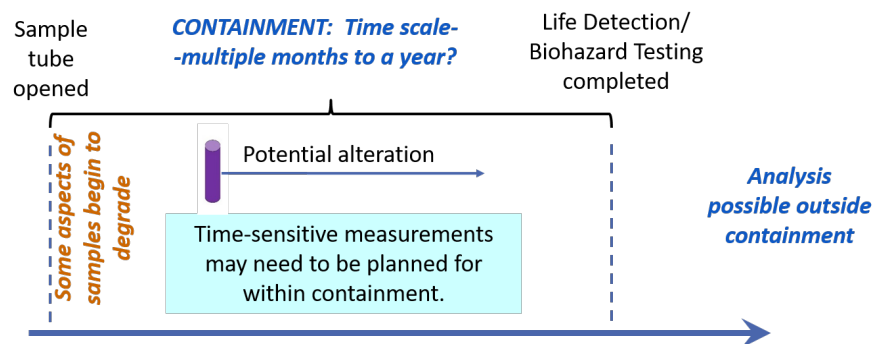
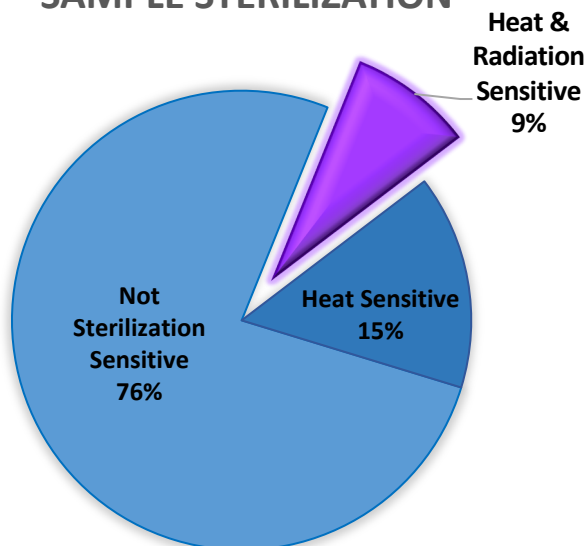


# Workshop #1-Science in Containment

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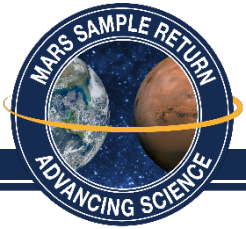
## What role does contained space need to play in ensuring that all MSR scientific objectives are met?

### SENSITIVITY OF MSR INVESTIGATIONS TO SAMPLE STERILIZATION



**FINDING:** Some properties of the samples will be vulnerable to degradation once sample tubes are opened, so some measurements will be time-sensitive

**MAJOR FINDING:** It appears that a large majority (>90%) of the MSR-related science investigations, as identified by the International MSR Objectives & Samples Team (iMOST, 2019), could probably be acceptably performed on sterilized samples, thus potentially enabling the analysis of MSR samples in uncontained laboratories without a dependency on the results from Sample Safety Assessment Protocol (SSAP) testing.

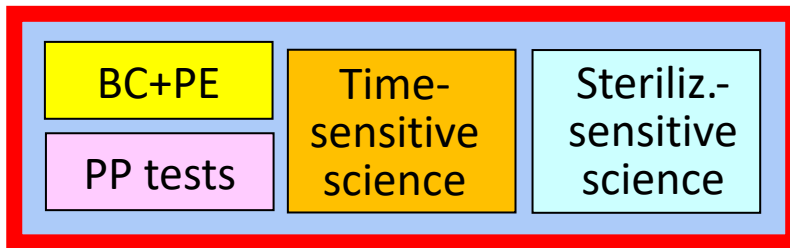


# Workshop #1-Summary

MSR Science Planning Group

What role does contained space need to play in ensuring that all MSR scientific objectives are met?

**Contained space  
functionalities implied**



+

Steriliz.-  
tolerant  
science

**Not contained**

OPTION A: Sterilize  
then analyze

OPTION B: Wait for  
PP tests, analyze  
unsterilized material.

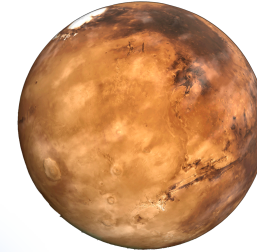
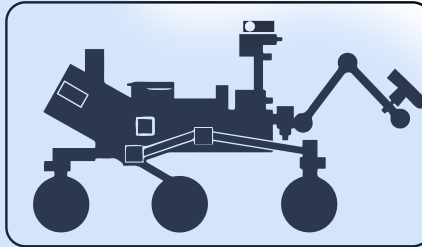
**MAJOR FINDING:** The scientific community, for reasons of scientific quality, cost, timeliness, and other reasons, strongly prefers that as many sample-related investigations as possible be performed in PI-led laboratories outside of containment.

**FINDING:** Space within containment must logically include functionality for BC+PE, SSAP tests, time-sensitive science, and sterilization-sensitive science. Sterilization-tolerant science can most effectively be planned outside of containment.

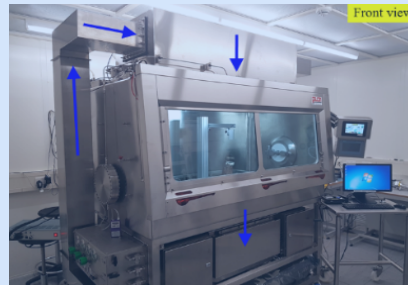
Earth-sourced  
contamination



Instruments:  
GC-MS etc.



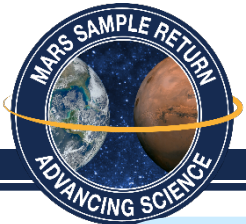
Mars-  
sourced signal



Receiving isolator

*Modified after OCP (2014)*

## What are our strategies to achieve MSR science objectives, given SRF-related contamination?



# Potential SRF Sample-Intimate Hardware Cleanliness Requirements

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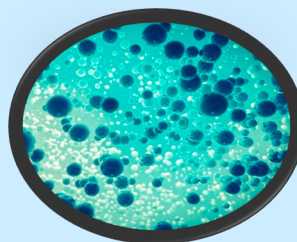
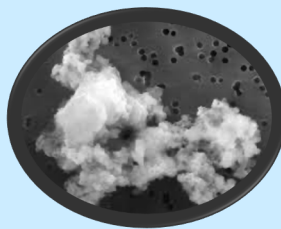
Viable Organisms  
( $<1$ )



Outgassing  
( $\sim 1$  ng/cm<sup>2</sup>/hr)



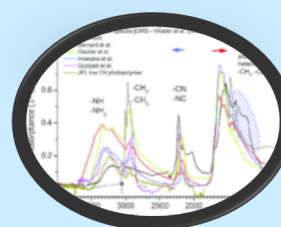
Particulate  
(PCL 50-300)



Total Organic Carbon  
Tier 1 Compounds: 1 ppb  
Tier 2: 10 ppb  
TOC: 10ppb

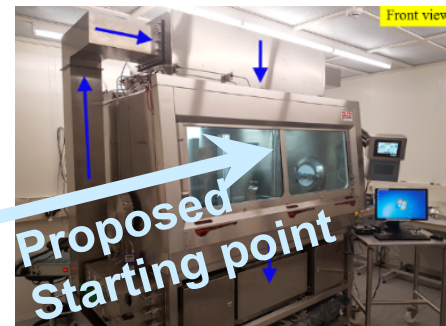


Inorganics pg-  
mg of 34  
elements



Non-volatile  
residue  
( $<100$  ng/cm<sup>2</sup>)

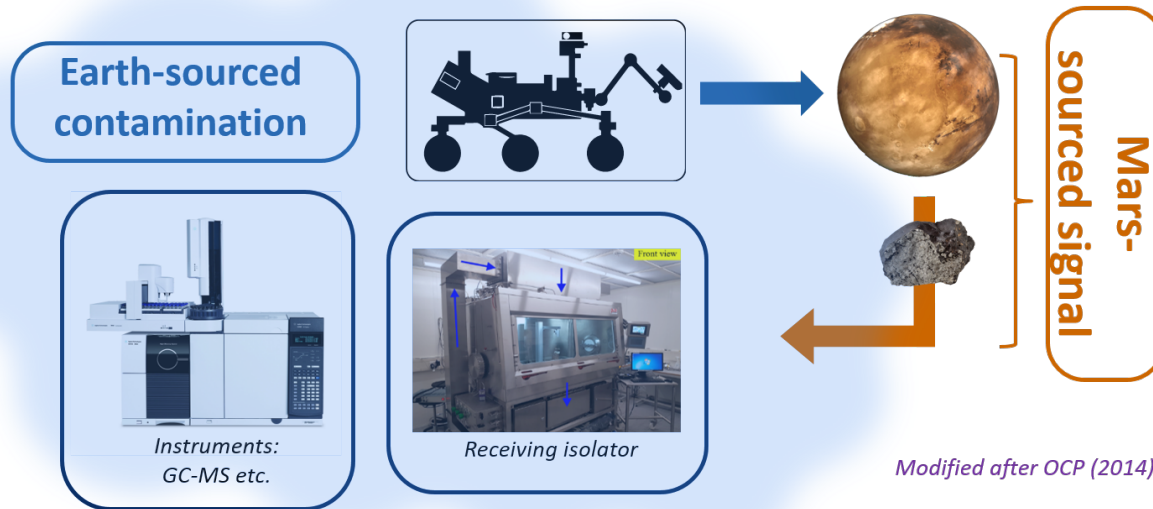
Notional sample-receiving isolation cabinet inside SRF (example only)



**NOTE: Select SRF reqs. should be more strict than M-2020**

## **For the SRF, requirements have not yet been established**

**MAJOR FINDING:** Even though the Mars 2020 Sample CC Requirements have very low values, the workshop participants were collectively not aware of reasons why these requirements could not also be implemented in isolation cabinets on Earth. This should therefore be the starting point for CC planning in the SRF and/or sample curation facilities.



## What are our strategies to achieve MSR science objectives, given SRF-related contamination?

- Establish CC requirements that are as (or more) ambitious/stringent/?? than Mars 2020 requirements
- Characterize contamination at all phases of MSR campaign and in SRF using multiple/optimized contamination knowledge (CK) strategies